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A NEW AND RAPID METHOD FOR DETERMINING FAT IN FRENCH FRIED POTATOES[1]

The production of frozen French fried potatoes has grown remarkably in recent years, reaching 482 million pounds in 1960 (1). Nearly all of this production is carried out in plants having facilities for quality control.

The fat determination is not only one of the most important analyses in the quality control of French fries but it is also the most troublesome, being complicated by the presence of 50-60% moisture in the French fries. Since water is immiscible with fat solvents, most methods for determining fat in water-containing products recommend drying. For French fries it is necessary to chop or disintegrate the slices in some way prior to driving off the moisture. The hot-solvent extraction techniques are too lengthy for use in quality control. Furthermore, they usually employ highly flammable solvents, require much laboratory space, and necessitate expensive apparatus. The method described here is simple, rapid and avoids the step of drying the fried potato tissue before analysis. A blendor is used to disintegrate the French fries in a liquid medium, which separates on standing into two phases; the upper one contains the extracted fat. The fat solvent is removed from an aliquot of the upper phase by the combustion procedure recently described by the authors (2).

Apparatus and Materials

See Fig. 1 for assembly of the apparatus used in determinations.

Aluminum, foil — approximately 0.001 inch thick and 6 inches square. These sheets may be made in quantity on a paper cutter, using alternate layers of paper to prevent adhesion of the pieces of foil.

Aluminum evaporating dishes — with tab handles, 58 mm diameter and 18 mm high; disposable, Will Corp. No. 11146 type.[3]

Blendor — 2-speed, 1-liter capacity, Waring type. The lid should be modified with a fume vent to prevent loss of sample around the lid. This vent is made by inserting the 50 mm long stem of a 50 mm diameter glass funnel into a tight-fitting hole drilled into the center of the jar lid (See Fig. 1).

Clock, stopwatch or timer — with large second hand.

Funnels — 5-inch diameter with large stem.

Funnels — Büchner, glass, 4-inch diameter.

Fume hood — (or ventilated room with draft shield on table).

Glass wool — Pyrex No. 3950 type.

Graduated cylinders — 10, 250 and 500 ml sizes.

Pipettes — transfer, 25 ml size.

Transite sheet — ¼ x 12 x 12 inches for each dish to be ignited simultaneously.

[1]Received for publication November 16, 1961.

[2]Eastern Utilization Research and Development Division, Agricultural Research Service, United States Department of Agriculture. Eastern Regional Research Laboratory, Philadelphia 18, Pennsylvania.

[3]Reference to particular products or companies do not imply their endorsement by the U. S. Department of Agriculture over others not mentioned.

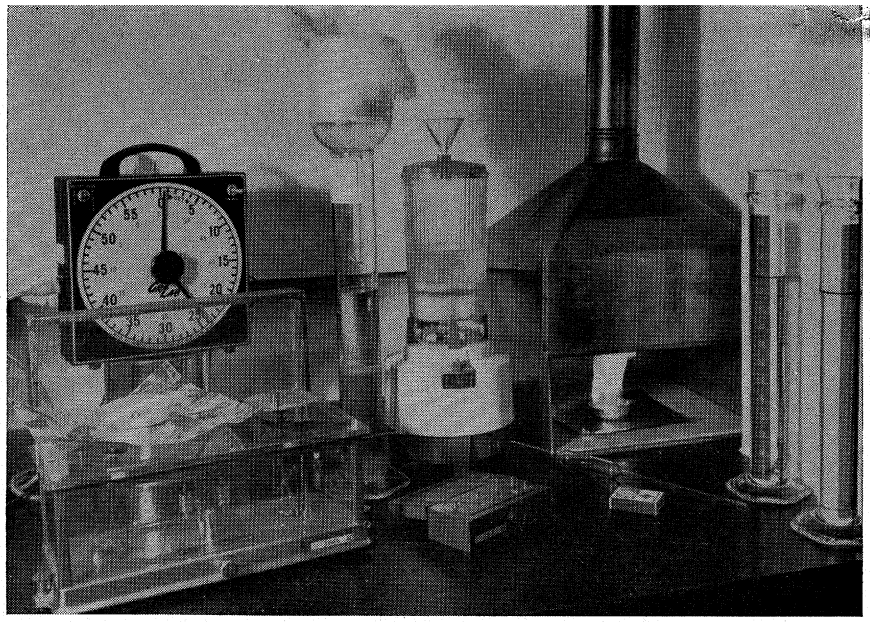

FIG. 1.—Assembly of apparatus used in determination of fat in French fried potatoes.

Torsion balance — 0.01 to 120 grams. The authors have found an automatic mid-range balance invaluable when many samples are being run.

Weights — balance, 1 to 100 grams.

Vacuum source — pump aspirator on water line.

Alcohol — ethanol, anhydrous, denatured, formula No. 19.[4]

Skellysolve B — 63 to 70 C boiling range.

Sodium chloride — technical grade, fine crystals.

PROCEDURE

Thaw the French fried potatoes if frozen, and weigh a 100.0 gram sample . If frozen, French fried potatoes often are covered with frost, or frost forms when the package is opened, and a sampling problem exists. For rush determinations, the pieces may be placed on a coarse screen and shaken to remove loose frost particles before weighing. This is of little benefit, however, unless much frost is present. Violent shaking should be avoided since it may remove some of the high-fat outside layer and influence the results. If time permits, the safest method involves rapid weighing, or thawing on a screen, draining, and lightly shaking off the excess water prior to weighing.

Transfer the weighed sample and about 10 grams of sodium chloride to the blendor jar in a well ventilated hood. The sodium chloride may

[4]"Completely" denatured alcohol formula #19 is of the following composition: 100 gal 200-proof ethanol, 4 gal methyl isobutyl ketone and 1 gal kerosene.

be measured with a spoon of appropriate size. Then add 75 ml of water.[5] 150 ml of the alcohol and 225.0 ml (measured accurately) of Skellysolve B. Cover and blend two minutes at low speed and one minute at high speed. Although the authors encountered no difficulty, a potential fire hazard exists when flammable solvents are mixed in a blendor powered by a non-explosion proof motor. For safe practice, the blendor should be used in a hood or fine mesh copper screen (Davy's safety lamp type) should be placed over the openings of the motor. Place a single (approximately ¼-inch thick) layer of glass wool, unrolled as a sheet from the outside of the roll, over a Büchner funnel, the stem of which is in the top of a 500 ml graduated cylinder. Press the glass wool lightly into the funnel to form a filter but do not tear since this filter is intended to remove most of the insoluble potato solids. Pour the contents of the blendor into the glass wool covered Büchner funnel. A quantitative transfer is unnecessary since only an aliquot of the filtrate will be used.

After about two minutes, squeeze most of the excess liquid from the glass wool and remove the funnel. Tare an aluminum foil weighing dish on an aluminum foil square, which may be labeled by the impression of a pencil when placed upon a paper tablet. The foil square retains any fat droplets that spatter during the subsequent burning procedure, since it is placed between the sample dish and the "Transite" sheet. The combustion should be carried out in a fume hood with the fan on and the window wide open to prevent excessive drafts. If it is desired to lower the burning temperature and reduce the smoke, add 10 ml of alcohol to the dish before ignition; however, this lengthens the burning time. Pipette 25.00 ml (cool if necessary) of the top layer in the graduated cylinder into the aluminum dish, ignite, cool and reweigh. Subtract the tare weight and multiply this weight difference by 9 for 100 g. samples.

Results and Discussion

All the tests used in the development of this method, unless otherwise specified, were made with a standard bath of French fried potatoes. These slices were made as uniformly as possible to minimize sampling error. "Chef's Special" Maine Katahdin 1960 crop potatoes were sliced ½ x ½ x 2¼ inches (5 sq in surface), washed, drained, fried in hydrogenated vegetable shortening at 350 F for seven minutes, sealed in polyethylene bags, and stored at 0 F until used. The laboratory-sliced potatoes, after frying, had 89 slices per pound, about 20 slices per 100 grams. Some commercial French fry brands are sliced in a ⅜-inch cross section and have about 130-160 pieces per pound. The laboratory-sized piece was selected because of convenience in other experiments.

In the development of this method, difficulty was encountered by formation of an emulsion during the mixing. Addition of sodium chloride, in the concentration specified, prevented emulsification and permitted the Skellysolve B solution to separate as the upper layer. Use of the large (100 gram) samples reduced sample error but necessitated removal of most of the suspended solids by glass wool in order to clarify the upper fat and

[5]If desired in the interest of more accuracy in measuring the aliquot at the end of the analysis, one can replace part of the water with ice to compensate for the temperature rise due to blending.

solvent layer. Proper solvent ratios are necessary for complete fat extraction from these large samples; high solvent-to-sample proportions prevent "over loading" with French fries of even the highest fat content. Complete sample disintegration with minimum heat rise was accomplished by running the blendor during part of the mixing period at low speed.

The adequacy of the disintegration was checked microscopically. Although the solvents used in the method tended to shorten the blendor jar bearing life slightly, the authors do not feel that the condition warrants the use of a more expensive top-bearing blendor.

If the foil, dishes and "Transite" are used exactly as specified, the fat loss due to combustion is less than 0.01 g for an aliquot. This is less than the inherent error in the method. No significant residue remained after blank determinations.

For French fry slices containing 8.03% fat, the standard deviation between the percentages of fat found in seven aliquots of the same blend was 0.07% (Table 1). Since this corresponds to the minimum weighing error, sample heterogeneity is obviously responsible for the bulk of the deviation in presence of water, the results obtained with the new method presented here were compared with those obtained by the more conventional method in which fat is extracted from dried tissue. Therefore, part of the standard French fried potatoes were carefully sliced open, oven dried, and analyzed according to our previous procedure shown to extract fat with accuracy and precision from potato chips (2), a low-moisture product.

TABLE 1.—*Determination of fat in French fried potatoes.*

Analysis by new method				Analysis of pre-dried French fries[1]	
Reproducibility on aliquots of same extract		Determination on replicate samples of French fries[2]			
% Fat	Mean	% Fat	Mean	% Fat	Mean
7.93		7.93		7.60	
8.02		7.48		7.60	
8.02		7.66		7.60	7.73 ± 0.12%
8.11	8.03 ± 0.07%	7.84		8.00	
8.11		7.66	7.74 ± 0.13%	8.00	
7.93		7.57		7.60	
8.11		8.02			
		7.93			
		7.75			
		7.57			

[1]By potato chip method given in Reference 2.

[2]Value includes errors in potato sampling and frying in addition to inherent error in method.

Table 1 shows that the new method yielded an average value of 7.74% at ± 0.13%, based on 10 samples from the standard batch. This compares well with the value of 7.73% ± 0.12% obtained on analysis of six samples taken from the same batch of French fries but dried before extracting with anhydrous solvents.

Table 2 presents data on the quantities of fat found in three commercial brands of frozen French fries, using the new method. Reproducibility of values was good for samples taken from these three lots, produced undoubtedly under widely different conditions of processing.

Little laboratory time or previous experience is required of the analyst to obtain accurate results with this method. An additional advantage is that the equipment is not expensive.

TABLE 2.—*Percentage fat found in samples of commercial frozen French fried potatoes.*

Brand	% Fat	Mean
"X" (160 slices per pound)	6.12 5.67 5.85 5.50	5.79 ± 0.41
"Y" (128 slices per pound)	4.23 4.41 4.41 4.68	4.43 ± 0.30
"Z" (130 slices per pound)	5.31 5.31 5.68 5.40	5.43 ± 0.28

SUMMARY

A rapid and accurate new-type method is presented for determining the fat content of French fried potatoes. The sample of French fries is disintegrated in a blendor type of mixer in the presence of water, alcohol, a liquid hydrocarbon, and sodium chloride. Most of the insoluble solids are removed by filtering through a pad of glass wool. The liquid mixture is transferred to a glass cylinder where, with the aid of the sodium chloride, it separates into two layers. An aliquot of the upper layer is removed and the hydrocarbon solvent is burned under controlled conditions. The residue of fat is weighed and its percentage of the sample weight calculated.

LITERATURE CITED

1. Bohannon, R. R. 1961. Procurement and processing of frozen potatoes. Part 1. Procurement. Quick Frozen Foods, 23(10) :34-36.
2. Ross, L. R. and R. H. Treadway. 1961. A new type, rapid method for determination of fat in potato chips. Potato Chipper, 20(11) : 44, 46, 50, 52, 56.